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# (12) UK Patent Application (19) GB (11) 2 139 674 A

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E01F 9/06

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Berger "Contramark" Reflective Road Stud made by  
Berger Traffic Markings Ltd, Fosseway, Midsomer  
Norton, Bath

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E1G  
C4S

## (54) Road marking stud

(57) A road marking stud comprises a flat plate (1) having a central rib (5) in which are embedded reflector beads (9). The plate and rib are moulded from a light-collecting and light-emitting transparent plastics material incorporating a fluorescent dye stuff. A flat surface (5) of the plate acts as a light-collecting area while an edge (4) of the plate and chamfered side (7) of the rib act as light-emitting surfaces which will glow even in overcast conditions due to total internal reflection within the plate.

Fig.1.

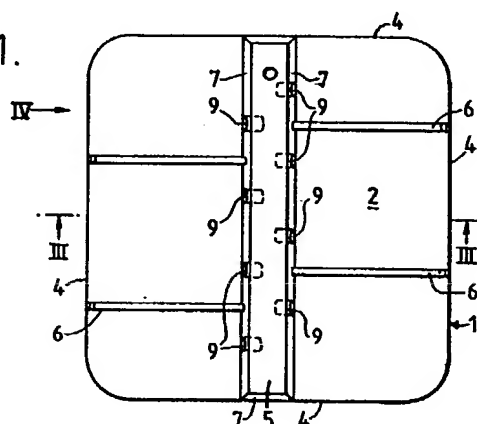
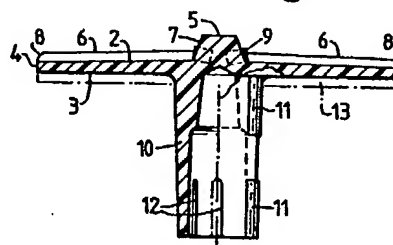


Fig.3.



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Fig.1.

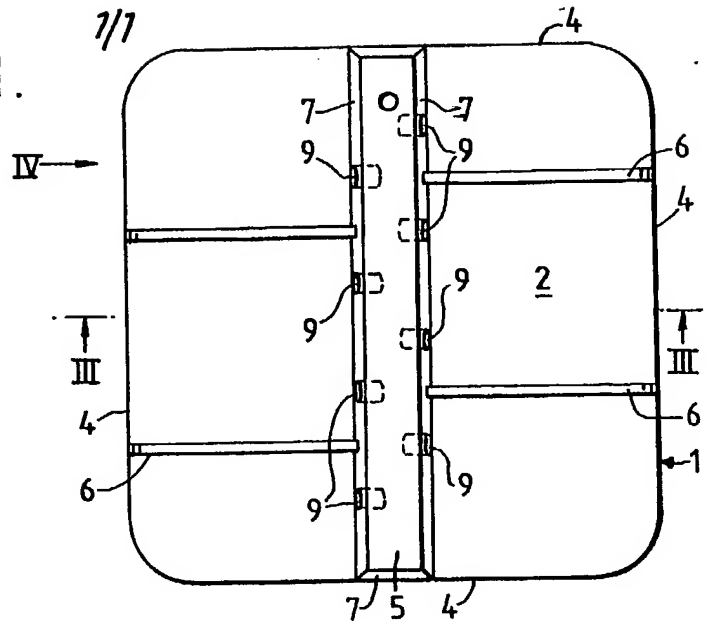


Fig.2.

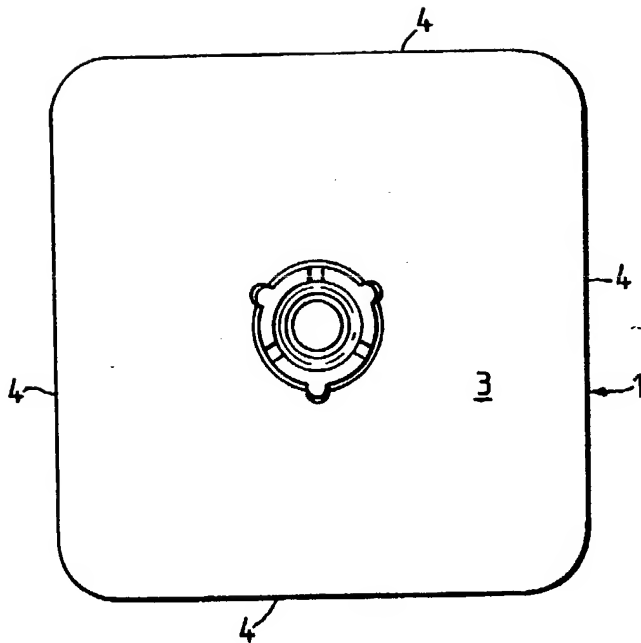


Fig.3.

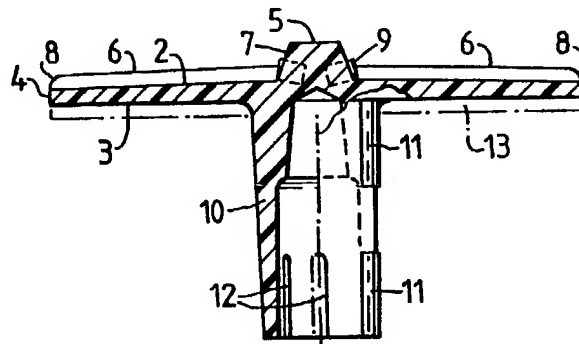
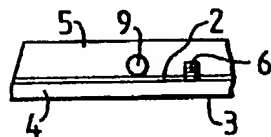


Fig.4.



## SPECIFICATION

## Road marking stud

- 5 This invention relates to road marking studs.
- Many different types of stud are in use for marking centre lines, traffic lanes and edges on roads, for marking predetermined lines on airport runways and for similar use. Studs, other than ones embodying a powered source of illumination commonly embody reflective material and are dependent for full visibility on light reflected from vehicle lights. Although effective at night, such studs give little guidance in foggy or overcast daylight conditions, or during twilight periods, particularly as many vehicles are still driven without their headlights switched on at such times. Indeed, such conditions are recognised as being among the more dangerous driving times and the object of the invention is to provide a road stud having increased visibility in such conditions.
- According to the invention a road marking stud has at least part thereof made from a light-collecting and light-emitting transparent plastics material incorporating a fluorescent dye stuff, said part being shaped to have an exposed light-collecting surface and an exposed light-emitting surface of lesser area than the light-collecting surface, the light-emitting surface being designed so as to be directed towards traffic when the stud is in position.
- Plastics materials as aforesaid receive direct and diffused light from the environment, and this incident light is absorbed by the molecules of fluorescent dye stuff. The light of fluorescence is emitted at random in the plastics matrix. Part of this light leaves the material through the light-collecting surface and part is absorbed within the body of the material. The remainder, due to the laws of total internal reflection travels within the plastics material and leaves the light-emitting surface thereof. By proper design of the shape of the plastics part, in particular by making the area of the light-emitting surface sufficiently small relative to the area of the light-collecting surface having regard to the refractive index and light-absorption capacity of the material, the light-emitting surface of such a part may emit an intensive glow. This effect is obtained even in overcast or otherwise generally poor daylight conditions.
- In order to give suitable night-time visibility the stud preferably also incorporates reflector means.
- There are many ways in which fluorescent plastics parts may be incorporated into road studs. Many types of studs now in use comprise a base member designed for securing to the road and a carrier having reflector means mounted thereon, the carrier being secured to the base member and in a number of con-

- structions being relatively movable to the base member so that it may be depressed by the wheel of a vehicle travelling over the stud. In a stud of this nature made in accordance with the invention, the carrier will incorporate parts of fluorescent plastics material as aforesaid to give good daylight visibility, desirably together with reflector means to give night visibility. There have been various proposals for wiping reflector means on such carriers, or for directing air or water jets onto the reflector means, all with the objective of keeping these in a clean condition, and any such means may be used in the cleaning of parts of fluorescent plastics material incorporated in the stud.
- Use of the fluorescent plastics material does, however, allow the departure from multi-part stud construction, and in a preferred embodiment of the invention the stud is in the form of a plate of the fluorescent plastics material, the upper surface of the plate forming the light-collecting surface and the edges of the plate forming the light-emitting surface. Such a plate may be attached directly to the road surface or may be attached to that surface by way of a resilient cushion between the stud and the road. To give extra security, the plate may be formed with a spigot capable of being embedded into the road surface.
- With the stud in such plate form it is desirable that the edges of the plate make an angle to the horizontal such that the emission of light therefrom is maximised along the path of vision of approaching drivers. That path differs between different types of vehicle and it may be desirable to have parts of the edge at different angles to the horizontal so that, for example, one maximises vision for car drivers and another for heavy goods vehicle drivers.
- Desirably a stud in the form of a plate may have upstanding formations from the upper surface of the plate, at least some of the edges of the upstanding surface also forming part of the light-emitting surface. Suitable design of such upstanding formations, particularly in relation to the angle of the edges of the plate, can further assist visibility of the stud over long distances and drivers of different types of vehicle. Upstanding formations also provide convenient locations for the mounting of reflector means for night visibility.
- Whether the stud is formed as a plate of the fluorescent plastics material, or whether that material forms only part of a multi-part stud it is desirable for the plastics material to have certain properties. Thus, it must be non-biodegradable, and resistant to weather and light without significant deterioration either of the plastics matrix or of the fluorescent dye stuff therein. In order to withstand traffic conditions it is also desirable that the plastics material be tough, shear resistant and abrasion resistant.

It is also preferred that the refractive index of the plastics material be between 1.45 and 1.60, in order to achieve a high level of total internal reflection, and thus good efficiency of light emission. Polycarbonate plastics have been found particularly suitable in meeting these requirements. One principal required characteristic of the dye stuff is that the light absorption and emission spectra should overlap as little as possible. Fluorescent dye stuffs having this property and capable of being incorporated in a suitable plastics matrix are known, and are available in a variety of different colours so facilitating distinctive marking of particular road areas.

In order that the invention may be better understood a specific embodiment of road marking stud in accordance therewith will now be described in more detail, by way of example only, with reference to the accompanying drawings in which:-

*Figure 1* is a plan view of the stud;

*Figure 2* is an underneath plan view of the stud;

*Figure 3* is a cross-section on the line III-III of Fig. 1; and

*Figure 4* is a fragmentary side elevation in the direction of the arrow IV of Fig. 1.

The road marking stud shown in the drawings is moulded from a fluorescent plastics material. The stud is in the form of a plate 1 having an upper surface 2, lower surface 3 and edges 4. A central rib 5 is upstanding from the upper surface of the plate and auxiliary ribs 6 extend transversely from the central rib to respective edges of the plate. The rib 5 has chamfered sides 7 and the ends of the ribs 6 that are remote from the rib 5 have rounded or chamfered ends 8 which merge into the associated edge 4 of the plate. A plurality of glass reflector beads 9 are incorporated in the rib 5 and open into the longer chamfered sides 7 of that rib.

The underside of the plate is formed with a spigot 10 formed with ribs 11 and slots 12. The spigot is designed to be inserted into a cavity in the road surface and to be locked in position in the cavity by any suitable material, such as concrete, a bitumastic material or other type of adhesive. When so located, the lower surface of the plate 3 either lies directly in contact with the road surface and is secured thereto by bitumen or other suitable adhesive material, or a pad 13 of resilient material is interposed between the surface 3 and the road surface, the pad adhering both to the road surface and to the stud.

The stud is desirably formed as an integral moulding of the fluorescent plastics material, the glass reflecting beads 9, if provided, being either moulded in situ or, after moulding, being inserted into recesses in the central rib 5 and held therein by adhesive.

The material from which the stud is formed is a transparent plastics matrix in which is

distributed molecules of fluorescent dye stuff of any required colour, the dye stuff having little overlap between the light absorption and emission spectra thereof. The refractive index of the plastics matrix is desirably between 1.45 and 1.60. Using such refractive index it can be shown that for every 100 light quanta incident on the upper-collecting surface 2 of the plate about 25 quanta leave the plate through the collecting-surface. Of the remaining approximately 75 quanta carried within the plate due to total internal reflection, some 20 to 30 are absorbed within the plate and other losses due to non-ideal conditions may account for a further 10 lost quanta. The remaining quanta, generally at least 40, are emitted from the edges 1 of the plate, from the chamfered sides 7 of the central rib 5 and from the ribs 6. All these surfaces thus emit a strong glow, coloured in accordance with the dye stuff used. Significant amounts of light are collected by the plate during daylight, even under overcast conditions and the glowing edges and ribs of the plate are thus readily visible, even at considerable distances.

In order to improve visibility of the plate to drivers of a range of different vehicles it is preferred if the angle to the horizontal of the edges 4 of the plate is different to the angle from the horizontal of the chamfered sides 7 of the central rib 5. If the former is greater than the latter then the edges 4 will be more distinctive from a low driving position and the sides 7 more distinctive from a high driving position. A suitable angle for the edge 4 is from 85° to 90°, and a suitable angle for the sides 7 is from 65° to 75°. The upper edges of the ribs 6 give visibility from above, so enhancing the studs' usefulness for aircraft guidance. For optimum night-time visibility glass beads are located in the central rib 5 so that the axis of each bead makes an angle of from 6 to 10° from the horizontal.

It will be appreciated that many modifications can be made to the studs as shown in the drawings, particularly as to the design of ribs or other projections on the upper surface of the plate and in the design of the stem projecting from the lower surface of the plate. The reflector means, when incorporated, may take forms other than that of the glass beads described, and may for example be in the form of a sheet of material embodying glass microspheres partially embedded in the surface thereof, the sheet being suitably fixed to part of the plate, or may embody corner cube prism reflex elements. The shape and relative proportions of the various parts of the plate may also be changed, the objective being to obtain the maximum possible glow from the plate while retaining a plate shape that is not prone to damage by vehicle wheels, that causes little impact on the wheels and that will readily be wiped clean by wheels passing over the plate.

**CLAIMS**

1. A road marking stud having at least part thereof made from a light-collecting and light-emitting transparent plastics material incorporating a fluorescent dye stuff, said part being shaped to have an exposed light-collecting surface and an exposed light-emitting surface of lesser area than the light-collecting surface, the light-emitting surface being designed so as to be directed towards traffic when the stud is in position.
2. A road marking stud according to claim 1, in which the stud also incorporates reflector means.
3. A stud according to claim 1 in which the stud is in the form of a plate of the fluorescent plastics material, the upper surface of the plate forming the light-collecting surface and the edges of the plate forming the light-emitting surface.
4. A stud according to claim 3 in which the plate is formed with a spigot capable of being embedded into the road surface.
5. A stud according to claim 3 or claim 4 in which the stud includes upstanding formations from the upper surface of the plate, at least some of the edges of the upstanding surface also forming part of the light-emitting surface.
6. A stud according to claim 5 in which the edges of the upstanding surface are at an angle to the horizontal that is different from the angle to the horizontal of the edges of the plate.
7. A stud according to claim 5 or claim 6 in which the upstanding formations carry reflector means.
8. A stud according to any one of the preceding claims in which the refractive index of the plastics material is between 1.45 and 1.60.
9. A road marking stud substantially as herein described with reference to the accompanying drawings.